Thank you

FOR YOUR INTEREST IN CORWIN

Please enjoy this complimentary excerpt from Data Minds.

LEARN MORE about this title!

CORWIN

Why Our Students Need Data Minds

1

It was the eve of one of the most significant events in recent history. The group of us gathered at Stanford University, nervously bumping our elbows in greeting instead of hand shaking, did not know the significance of the days that lay ahead. We were one of the last meetings to take place at the university before it officially closed its doors for the duration of the "social distancing" time. It was March 2020, and much conversation and news was focused on data—particularly the data surrounding the spread of the virus that later became known as COVID-19. But for the group of us there that day, we were focused on data more generally and the role it could play in educating students, empowering them to make sense of and tackle important issues in their lives. Our group included thought leaders in education, mathematics, statistics, data science, and technology, some of whom had flown in from other countries. We all knew that helping students become data literate would protect them from the world of misinformation lying in wait for them and help them make informed decisions to improve their own lives and those of others in their communities.

One question that took up much of the group discussion was how teachers can add content to their already full plates. We recognized that a part of **data literacy** is mathematical, but we also knew that understanding, reading, and communicating about data involves many important parts of the curriculum, including the humanities and arts, and knowledge that draws from science, history, sports, geography, and more. Data literacy is a truly cross-curricular goal that makes it perfect for teaching in the elementary years and shines a spotlight on the limits of subject boundaries. In the years since that meeting, we have met many wonderful teachers who are not adding content to their already full schedules but instead are teaching the content they have always taught, with a **data flair**. The teachers come from elementary, middle, and high schools, with some middle and high school teachers collaborating across subjects to engage

Data literacy: used to describe whether a person can read, understand, utilize, and communicate data in different ways.

Data flair: describes a teacher incorporating data into their typical lessons.

1

students in data investigations across the school. At the heart of these teachers' work is their understanding that when they teach their usual subjects with data the ideas come alive.

Data Minds

Taking a data perspective does not need to mean big shifts for us as teachers—it can be as simple as a decimal number describing a plant's height in the classroom, or a science investigation of whales including data on their sounds in the ocean, or an art project creating beautiful data visuals of students' pet behavior (Figure 1.1). We will share ideas like this for incorporating data in all subjects throughout the book. Helping students become data literate is an important goal for every educator, especially as we are living in a world increasingly full of misinformation created to mislead. This book is intended to help you, teaching any subject or any grade, bring a data flair to your teaching, helping students to develop **data minds** and navigate the data-filled world in which they live.

Data minds: describes an openness toward data, a curiosity about data in the world, and the willingness to record, study, and reflect upon data.

FIGURE 1.1   Whales Are Among Nearly Limitless Possibilities of Subjects for Data Analysis

Source: istock.com/Jonas Gruhlke

In this book we describe the teaching goal of developing data literacy as one that means encouraging *data minds* because those who are comfortable working with data usually exhibit certain *habits of mind* (H. Lee et al., 2022). We are particularly highlighting five ways of approaching knowledge that we will return to as we discuss the different teaching cases. As students learn to approach knowledge with these habits of mind, they will be helped not only in their development of data literacy but also in their learning of all subjects and even in their approach to life. The five habits of mind position students actively, giving them a role in seeking and investigating knowledge deeply.

Data in the World

Our world has changed in a few dramatic ways over recent years, one being the immense wave of data that has crashed down upon all our shores. Since 2009 (the Obama era), the federal government of the United States has been working to make datasets freely available.

It is hard to watch TV or read news or sports sites without being presented with interesting data and **data visualizations**. People in a multitude of jobs and life circumstances have found data, coupled with the power of new technological tools, to be so helpful that by the end of 2020 we, as a society, had generated ten times as many bits of data as there are stars in the universe (Messy Data Coalition, 2020). And the proliferation of data continues— every few years the volume of data across the world doubles in size! Jobs abound for those who have developed the ability to investigate data, and data analysts are in high demand. But you don't have to be a specialist to benefit from data literacy: Almost every employee— every *human*—will be more helpful and effective if they are comfortable working with data.

Data comfort and data literacy not only help people in work but also in all aspects of their lives. Everybody needs to look after money, for example, and these days a true understanding of health requires an understanding of data. Many of us carry fitness devices that give us continuous data on our workouts and movement. The graphs that filled our TV screens during the pandemic, and the spread of misinformation about vaccines, underscored the need for a data literate population.

Data literacy is not, as some might think, about teaching students statistics—statistics are a part of data literacy, but there is so much more, including the development of inquiring, curious minds. The journey to become data literate should start in pre-kindergarten and develop across

GOVERNMENT DATASETS

https://qrs.ly/eygncio

To read a QR code, you must have a smartphone or tablet with a camera. We recommend that you download a QR code reader app that is made specifically for your phone or tablet brand

Data visualization: a visual representation of data.

By the end of 2020 we, as a society, had generated ten times as many bits of data as there are stars in the universe.

GAISE REPORTS

https://qrs.ly/logncip

GEORGE LAND
VIDEO ON
CREATIVITY IN
STUDENTS

https://qrs.ly/m5gncoc

the grades, with students coming to know data—of different forms, whether they be numbers, colors, feelings, or soft toys—asking questions, developing curiosity, and communicating their findings. The Gaise Reports, authored by professional statisticians, emphasize the importance of data literacy extending across all grades and contain a wealth of ideas for lessons and teaching moves. These are aspects of teaching and learning that all teachers can learn to do, and that can become a highlight of anyone's classroom day.

Data Literacy and Creativity

The opportunity to develop curious data minds is one of the most valuable aspects of data literacy, and one that our school system desperately needs. Many of us are aware that the school system's current focus on disconnected standards and standardized tests is the enemy of creative thinking, and teachers need all the help we can get, to keep nurturing creativity in students. George Land, was an author, speaker, consultant, and general systems scientist and an advocate for creative thinking. During his time developing methods to help organizations develop innovation and creativity, he and Beth Jarman, a leading educator, were approached by NASA and asked if they could develop a test for their staff that would show which of their staff were most creative and could be put on the top teams. The test they developed was found to be very predictive of employees' success in work. The test asked people to find different uses for well-known objects (such as forks) and solve problems in new ways. After developing the test for NASA, Land and Jarman decided to give it to four- and five-year-olds. They were stunned to find that 98% of the young children scored in their "genius" category on creativity. This prompted them to follow the children over time and give the same students the test again five years later. By the time the students were 10, the proportion classed as highly creative had fallen to 36%; at age 15, the proportion fell to 12%. When they gave the same test to hundreds of thousands of adults, only 2% of them showed creativity (Land & Jarman, 1992; TEDx Talks, 2011). Many analysts lament the fact that students are rarely encouraged to use creativity in schools, but recent research is showing that when people engage in curiosity, their brains come alive with activity as the brain engages in a "complex dance between the frontal lobes and the default network" (Create Potential, 2025, Section "The Brain's Electric Dance," para. 1; also Beaty et al., 2014). Others have pointed out that when we encourage students to be curious, it protects them from adversity in life, as the brain becomes more able to adapt when people face situations that cause emotional or cognitive distress (B. Lee & Lee, 2016; Metzl & Morrell, 2008).

Curiosity is often discussed and valued by designers, artists, and education visionaries; it is less typically highlighted, but just as important, in science and mathematics, and data investigations bring this to light beautifully. Any scientist or mathematician starts with a question she is curious about and then collects data or develops reasoning to investigate it. When we invite students to become data literate, we should encourage them to come up with their own questions that they are curious about. Later chapters will develop the ways we as teachers can encourage students to cultivate a curious, question-asking mindset. What is clear is that we cannot leave the important role of creating data-literate students solely to teachers of mathematics. The responsibility—and the opportunity—extends to all of us working in education, across disciplines and across grades.

> When we invite students to become data literate, we should encourage them to come up with their own questions that they are curious about.

Equitable Opportunities

There are many ways in which giving students opportunities to become data literate could contribute to the creation of more equitable opportunities for students. Achievement in our school system is sadly often predictable by students' race, gender, and socioeconomic status, and all the myriad ways privilege and oppression intersect (Crenshaw, 2015; Tate, 1997). The proliferation of online and other resources available to homes with resources only serves to widen long-standing equity gaps. This is why we are committed to providing ideas and resources that can be used inside schools. As our classrooms teach students to become data inquirers, we will also help students become critical thinkers who are able to read and understand the world. As students become data empowered, they will be in a better position to advocate for themselves and to make real change in their lives and in the lives of their communities.

Just as we are aware that our world is being filled with data, we are also aware that our students are not developing the knowledge they need to make sense of data (Mendez-Padilla, 2025). Studies have found that students often cannot determine the validity of data presented to them, whether scientific (Zucker et al., 2020) or political (Kahne & Bowyer, 2017), and they are unable to detect bias in online sources (Wineburg et al., 2016). Even the statistical knowledge that is part of data literacy is not being taught in many schools. There is not a great deal of emphasis on statistics in the U.S. mathematics standards, but even the statistics that are mentioned are not being well learned, as the graph in

Figure 1.2 shows, with a clear decline in students' statistical proficiency as they move through the grades.

FIGURE 1.2 Percentage of California Students Meeting Standards in Statistics or Data at Different Grade Levels

Percent
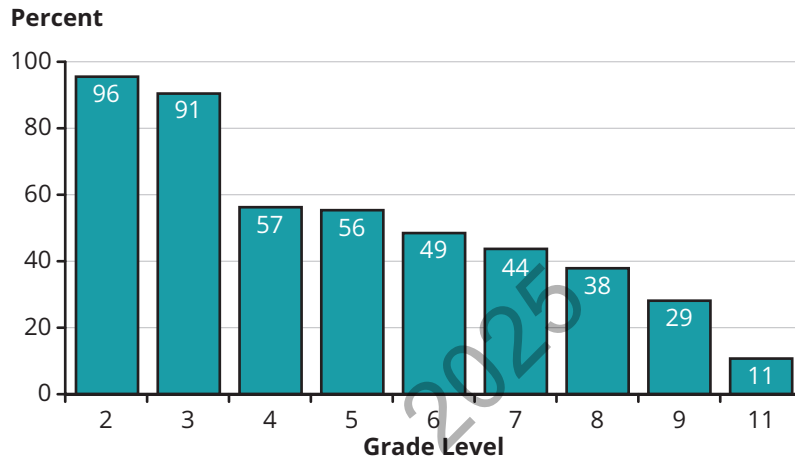
Students from 21 school districts in California meeting data or statistics standards assessed through MARS assessments (n = 14,574).

Source: Data from Silicon Valley Mathematics Initiative's Mathematics Assessment Collaborative: Mathematics Assessment Service (MARS) and California Assessment of Student Performance and Progress (CAASPP) Technical Report by Educational Data Systems, 2018.

A postfactual world: a world where the truth, honesty, and facts take a back seat to opinions, and misrepresentations are deliberately shared to mislead and manipulate people.

It is critical we empower young people to resist this postfactual world and help them examine any data results presented to them with a critical lens so that they can separate fact from fiction and propaganda.

The lack of attention paid to statistics and data literacy more generally is a serious equity issue that threatens not only the education of individual students but also the preservation of our democratic society, because it leaves students vulnerable to those who want to mislead them. The spread of misinformation in the world, whether it is contributing to faulty election results, or the "canceling" of people, or resistance to scientific fact (Furnham & Robinson, 2022; Lukianoff, & Schlott, 2023; Micich & Cross, 2023), is accelerating worldwide. It is critical we empower young people to resist this **postfactual world** and help examine any data results presented to them with a critical lens so they can separate fact from fiction and propaganda.

Neglecting data literacy also means denying students the opportunities to learn with the accessible and often free data tools that could help them in

their lives. This was brought home to us recently when we were interviewing a group of students who had taken the high school data science course we have made freely available on our Stanford site: youcubed.org. We asked the students what they thought about the class, and one of the seniors immediately shared that he was working in a theater as a lighting designer after school and could now do calculations with Excel sheets in 30 seconds that, prior to the course, had taken him 45 minutes to do by hand. Later he shared with us that despite being a senior in high school, he had never been introduced to spreadsheets before. This may seem shocking, but it is not unusual.

STUDENT OPINION ON DATA SCIENCE COURSE

https://qrs.ly/rdgnciq

Learning for Life

Elliot Eisner was a Stanford professor, best-selling writer, and champion of the arts in education. He shared many important insights about education and learning, one of them being a statement that should be obvious but somehow gets lost in educational policy making. He pointed out that the function of schooling is not to enable students to do better in school. The function of schooling is to enable students to do better in life (Eisner, 2003). This realization should play a much bigger role in educational policy and planning than it does now, as it is clear to many of us that much of the content taught in schools, and valued by college admissions, is there to preserve traditions, rather than to prepare students for their lives and their ever-changing futures. Data science, as a high school course, has the potential to disrupt long-standing inequities in mathematics pathways and focus on the content students need in their lives, two reasons that it seems to be a controversial proposition for some. The course has been challenged by some traditionalists, even as, or perhaps because, it diversifies the students going forward in STEM (Boaler et al., 2024).

> "The function of schooling is not to enable students to do better in school. The function of schooling is to enable students to do better in life."
>
> —Elliot Eisner

> Data science, as a high school course, has the potential to disrupt long-standing inequities in mathematics pathways and focus on the content students need in their lives, two reasons that it seems to be a controversial proposition for some.

Steve Levitt, an economics professor at the University of Chicago, and author of the famous *Freakonomics* book series (e.g., Levitt & Dubner, 2005, 2020), became interested in the mathematics his high school children were learning in school when he helped them with homework. He noticed a huge disconnect between the mathematics they were learning

and the mathematics he used as a professional economist (Boaler & Levitt, 2019; Freakonomics, 2019). He recognized the mathematics they were learning as the same content he learned in school. Steve's interest in students' mathematics pathways led him to us; he also attended the March 2020 meeting that opened this chapter. His team at the Freakonomics website posted a survey on their site. The survey asked what mathematics people used in their lives. The results are shown in Figure 1.3.

**FIGURE 1.3   Freakonomics Results: How Often Do You Use This Mathematics in Your Life?**

Percent of Respondents
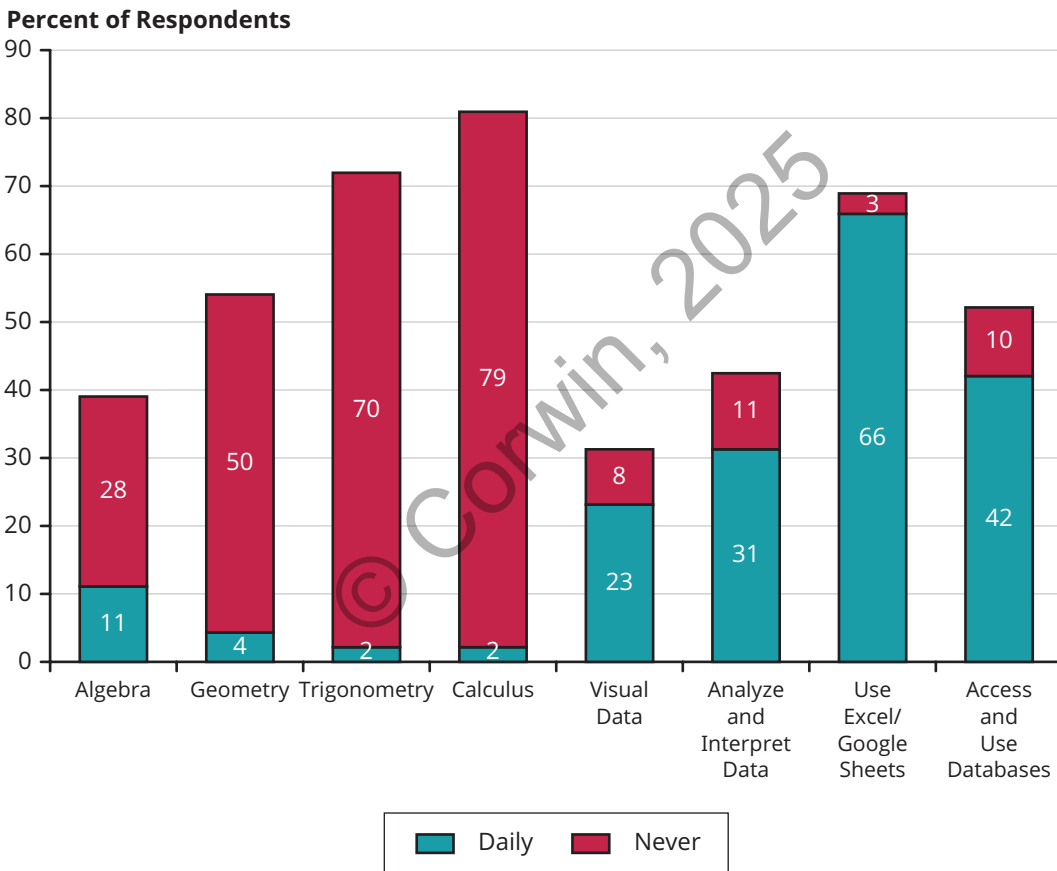
Source: youcubed.org.

FREAKONOMICS WEBSITE

https://qrs.ly/z5gncir

The Freakonomics team was worried that their data was skewed toward men and economists, who are the ones who populate the website in higher numbers, so we gave the same survey to more than 1,000 educators at a conference for leaders. These results are shown in Figure 1.4.

FIGURE 1.4   Educators Results: How Often Do You Use This Mathematics in Your Life?

Percent of Respondents
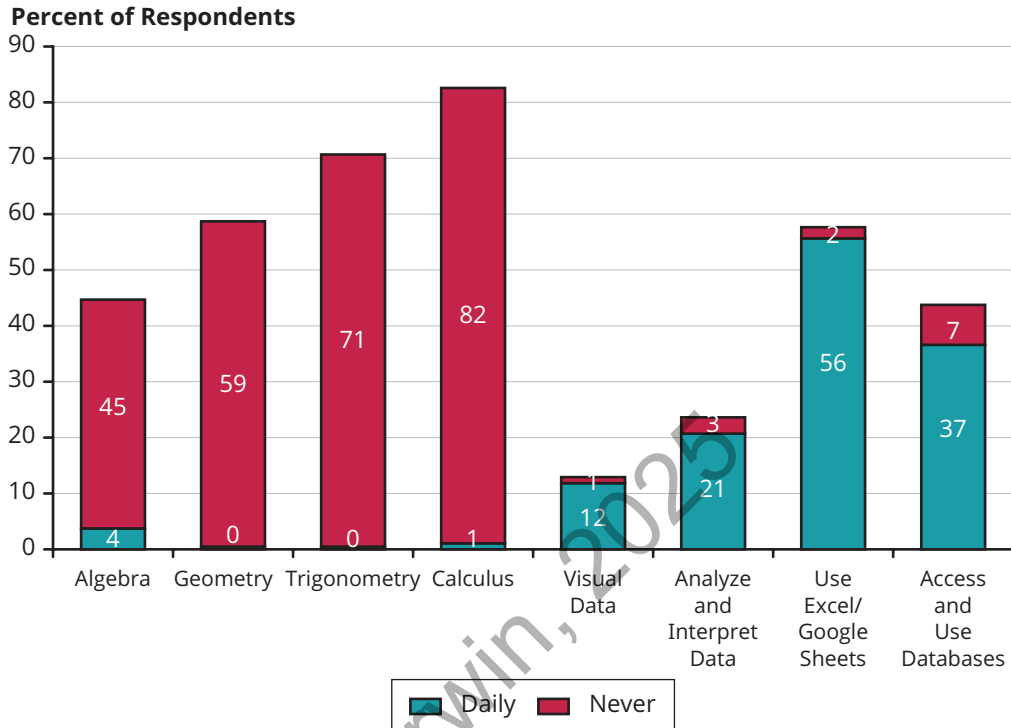
Source: youcubed.org.

It may be that people use algebra, geometry, trigonometry, and calculus more than they think, but whether this is true or not, the surveys clearly show that people in the modern world need to visualize, analyze, and interpret data and use spreadsheets and databases frequently. However, these are competencies that are not typically taught or even encouraged in U.S. schools.

Summary

We know that teaching students to be data aware helps young people navigate their worlds, which is important enough, but it does something else, just as important, and often extremely difficult for us as educators—it helps students develop into *the kinds of learners* that will help them throughout their studies and their lives. Effective learners are curious and intrinsically motivated to learn, they engage with agency, using their own ideas in the learning process, and they seek patterns in the world, always looking beyond what is obvious to uncover relationships and connections. These are the

skills required to be lifelong learners, which is increasingly necessary in ever-evolving career pathways and in our data-filled lives. They are also the skills that are taught as students take part in data investigations, as the rest of the book will highlight.

Reflection Questions

1. How do you use data in your life?

2. Reflect on the statement "The function of schooling is not to enable students to do better in school. The function of schooling is to enable students to do better in life."

3. We and Freakonomics asked people what mathematics they used in their lives. Were you surprised by the results? Did the results reflect your own experience?